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Lin et al.

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(54) **TOUCH DISPLAY APPARATUS**

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(30) **Foreign Application Priority Data**

Jul. 17, 2013 (TW) ..... 102125559 A

(51) **Int. Cl.**

G02F 1/1335	(2006.01)
G02F 1/1333	(2006.01)
G06F 3/041	(2006.01)
G06F 1/16	(2006.01)

(52) **U.S. Cl.**

CPC ***G06F 3/041*** (2013.01); ***G06F 1/1643*** (2013.01); *G02F 1/13338* (2013.01); *G02F 1/133308* (2013.01)

(58) **Field of Classification Search**

CPC G02F 1/13338

See application file for complete search history.

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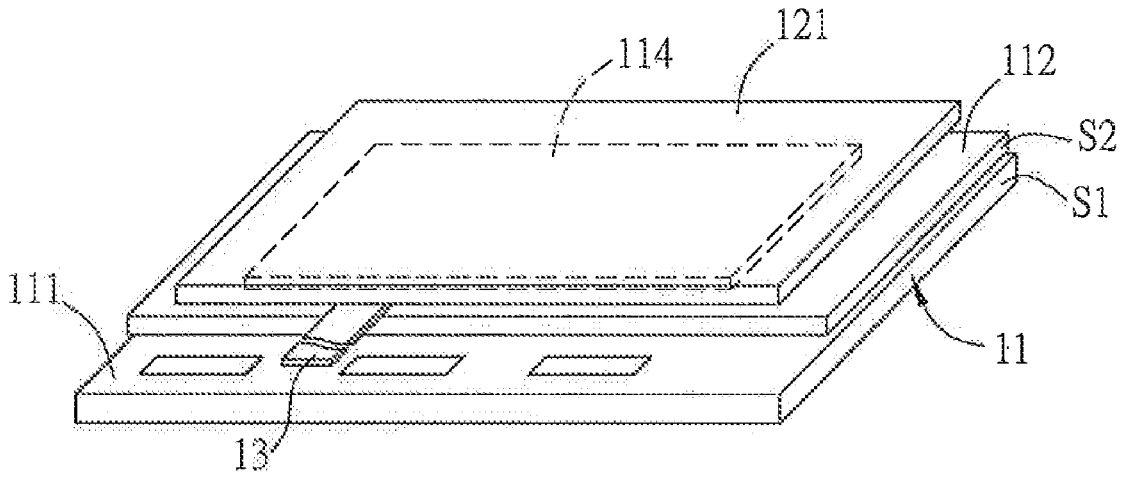
(57) **ABSTRACT**

A touch display apparatus comprises a display panel and a touch panel. The display panel includes a first substrate and a second substrate disposed oppositely. The first substrate has a first side, the second substrate has a second side corresponding to the first side, and the first side is disposed beyond the second side. The touch panel includes a touch substrate. The second substrate is disposed between the touch substrate and the first substrate, and the area of the touch substrate is less than or equal to that of the second substrate.

15 Claims, 19 Drawing Sheets



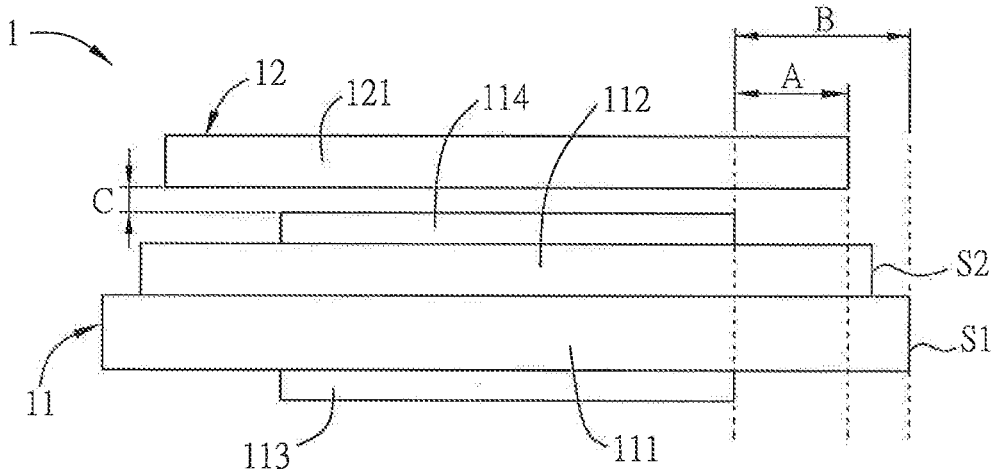


FIG. 1

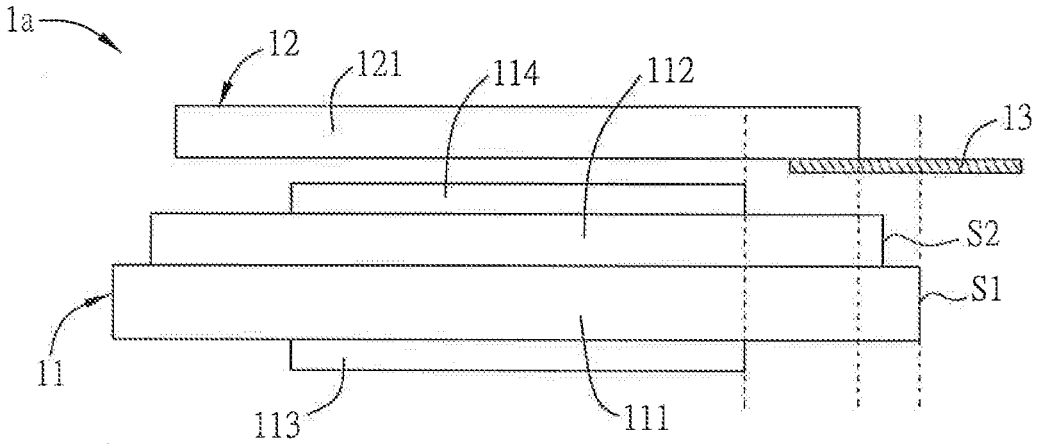


FIG. 2A

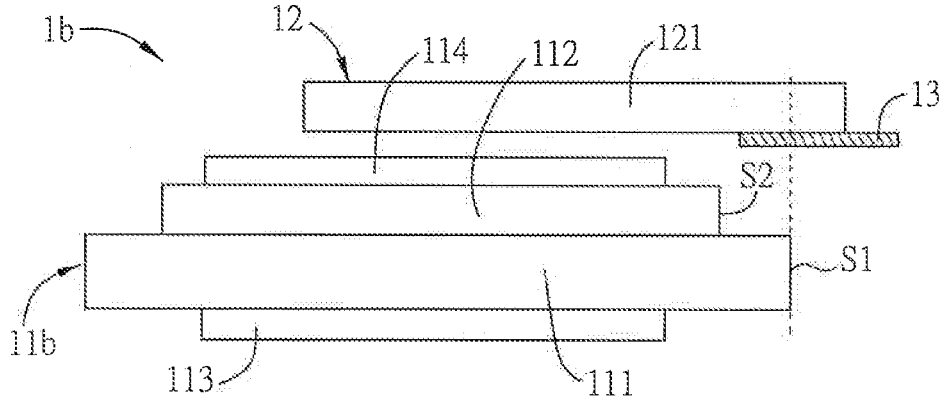


FIG. 2B

FIG. 3A

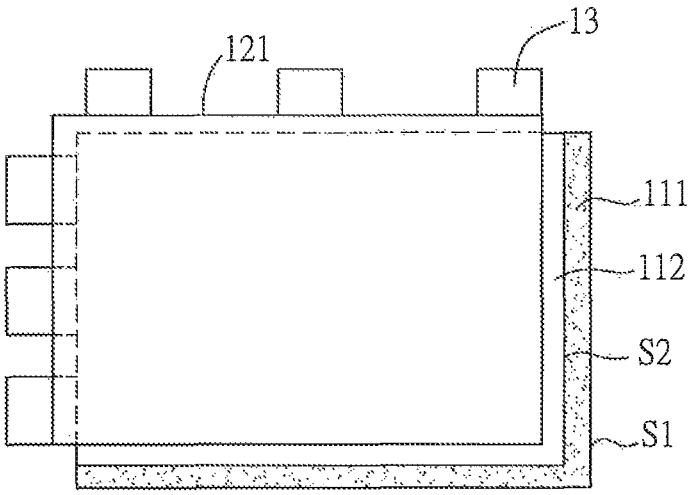


FIG. 3B

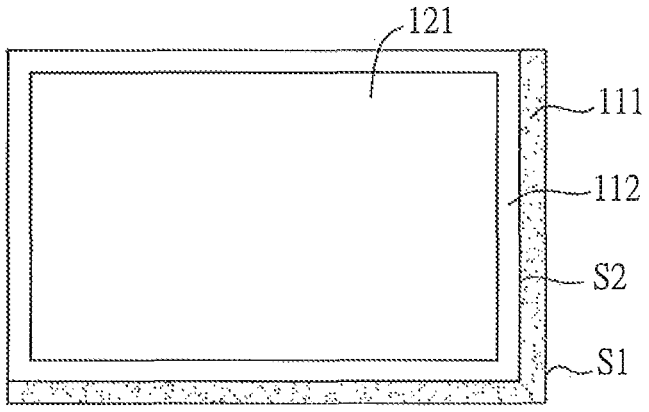
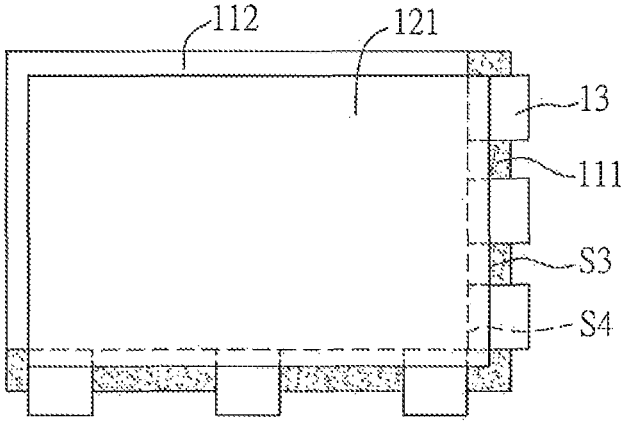


FIG. 3C



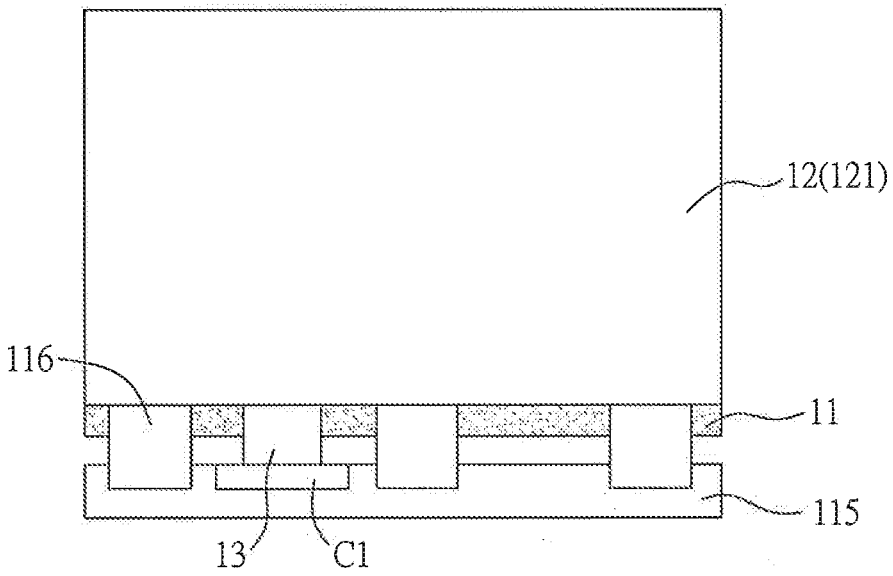


FIG. 4A

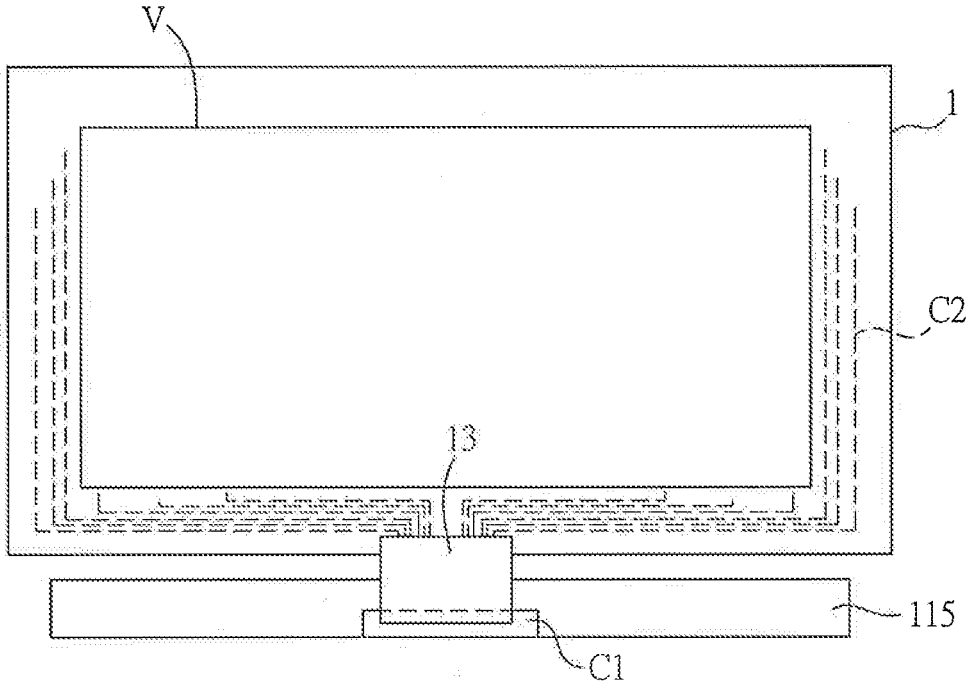


FIG. 4B

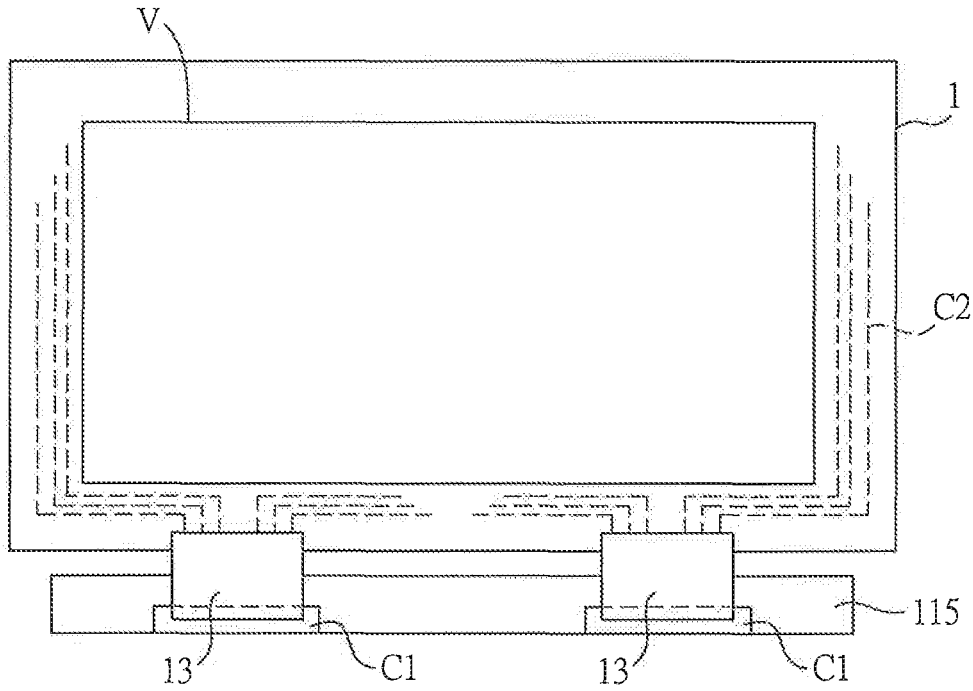


FIG. 4C

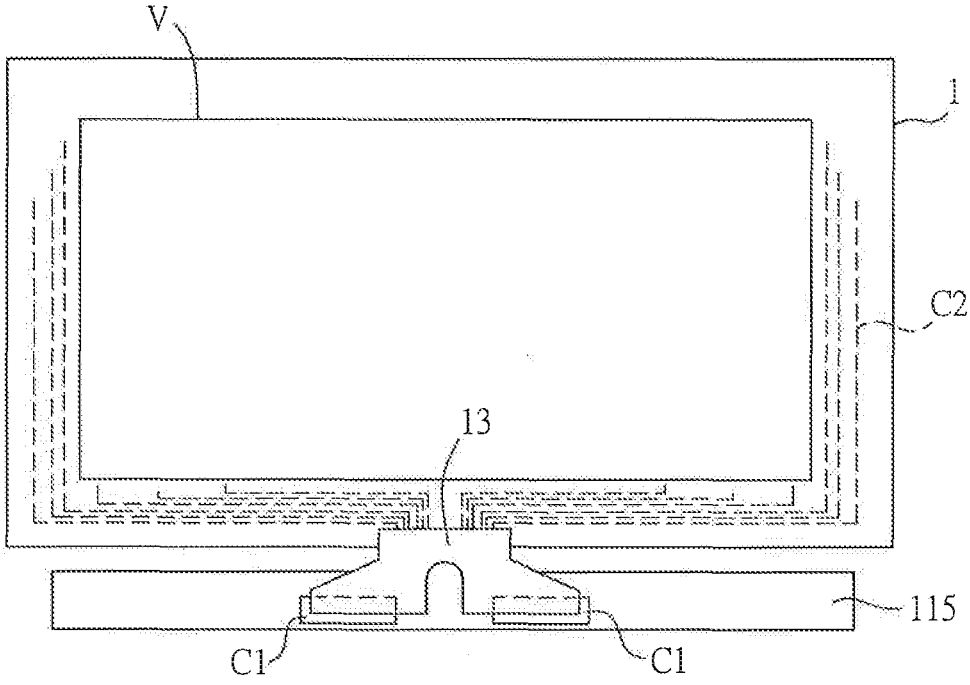


FIG. 4D

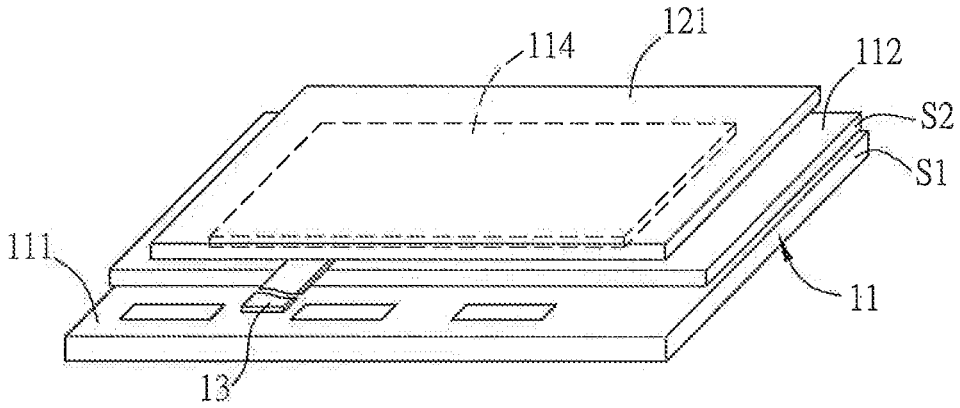


FIG. 5

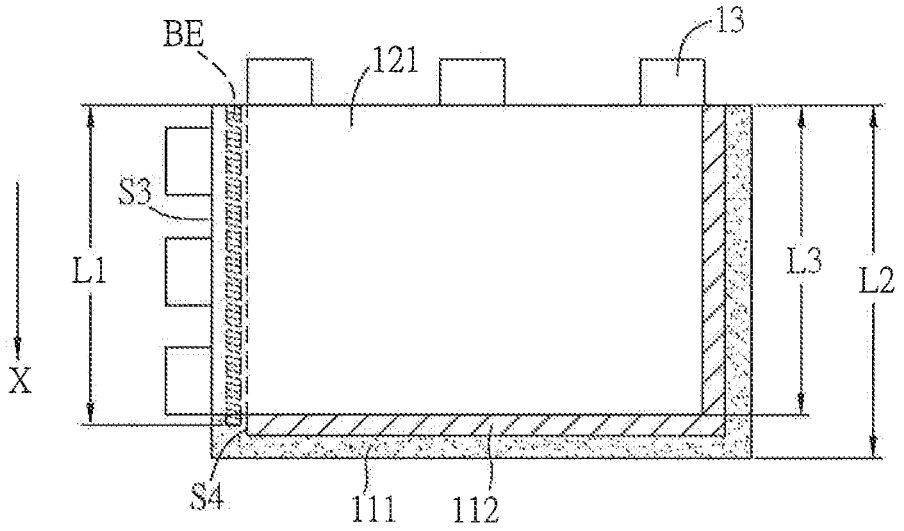


FIG. 6

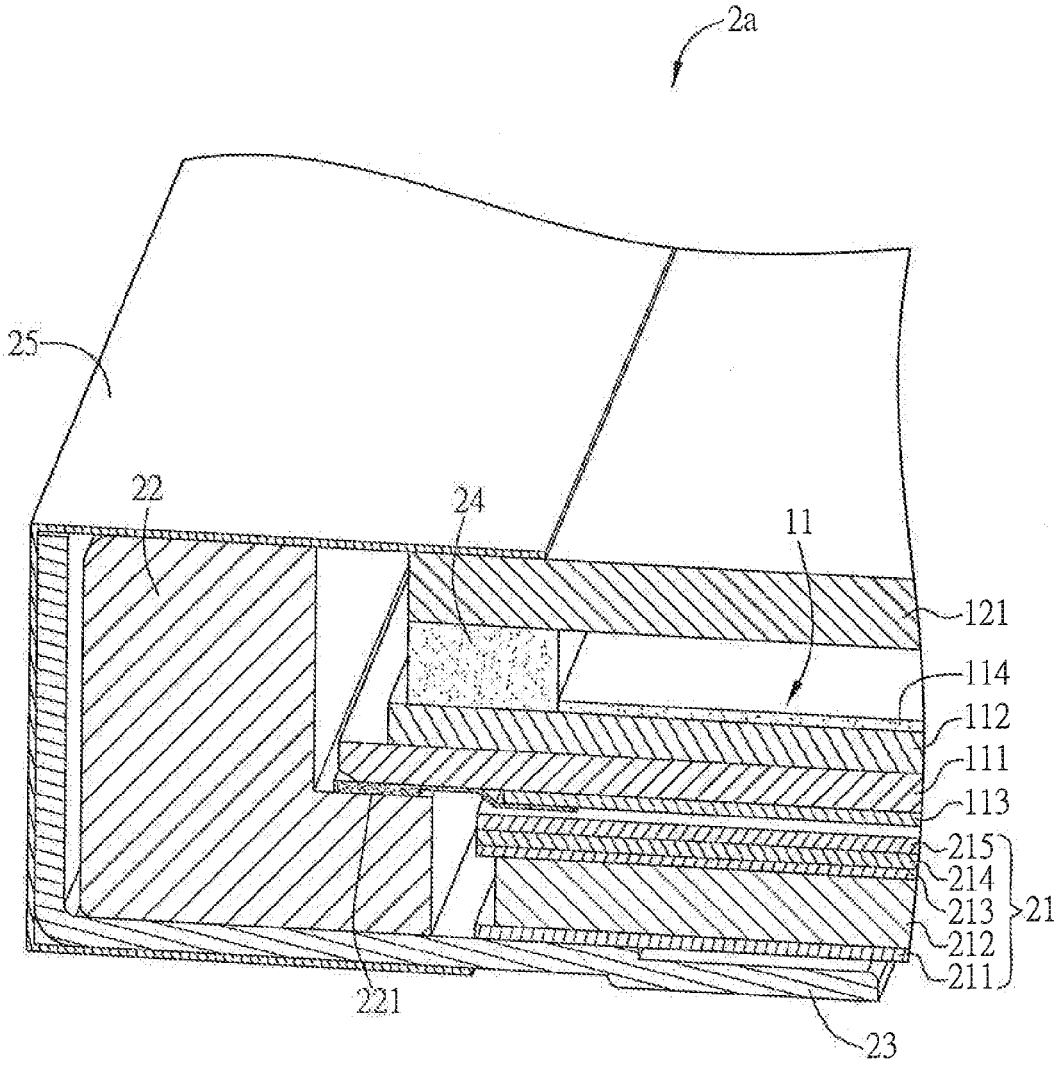


FIG. 7A

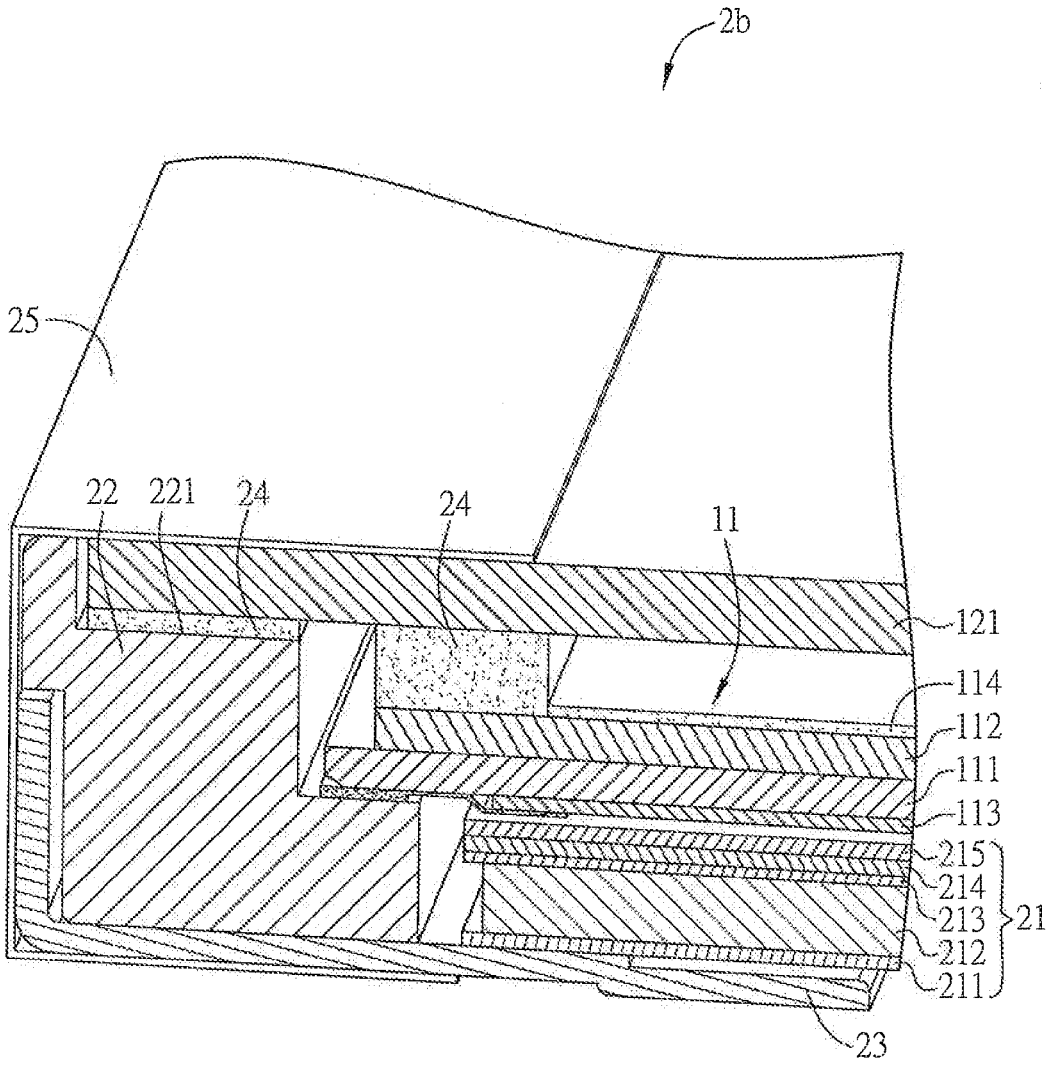


FIG. 7B

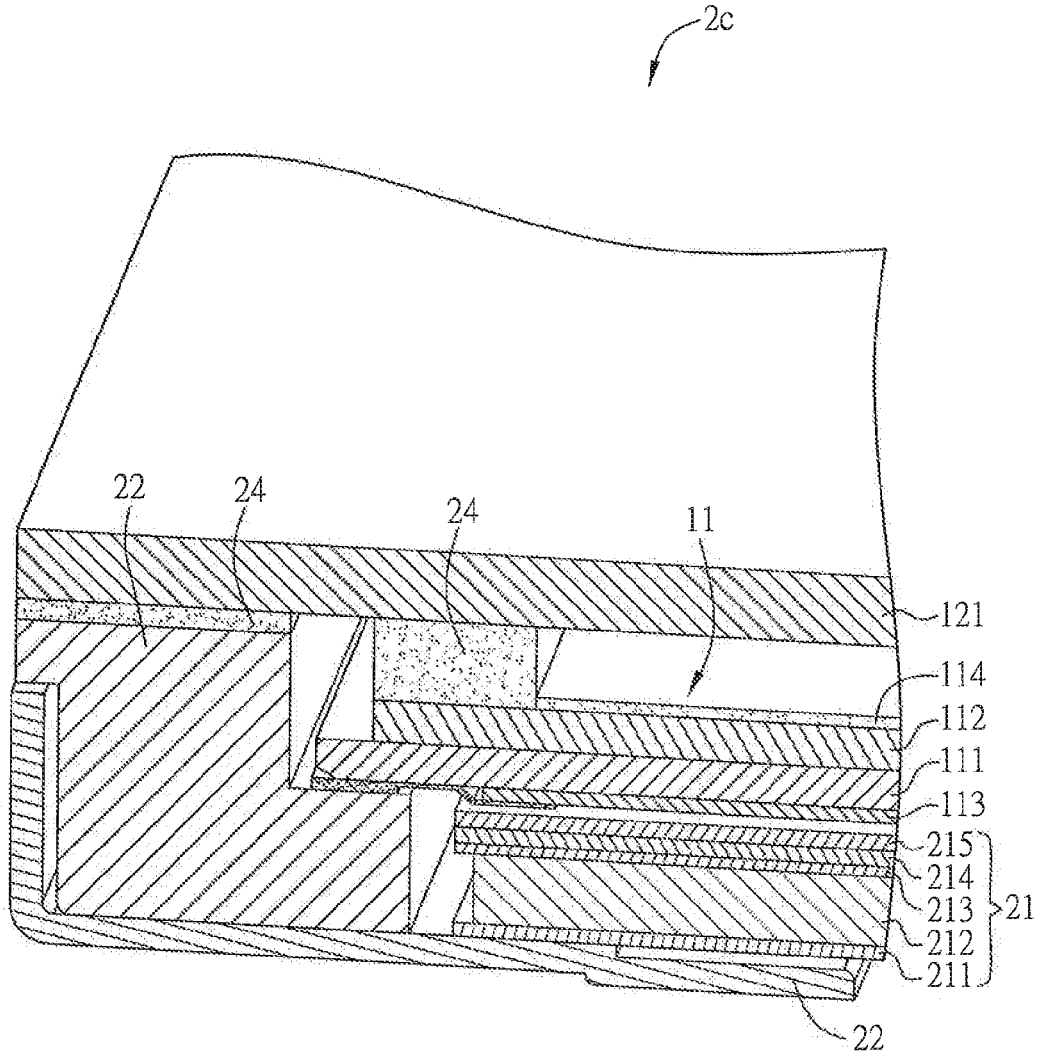


FIG. 7C

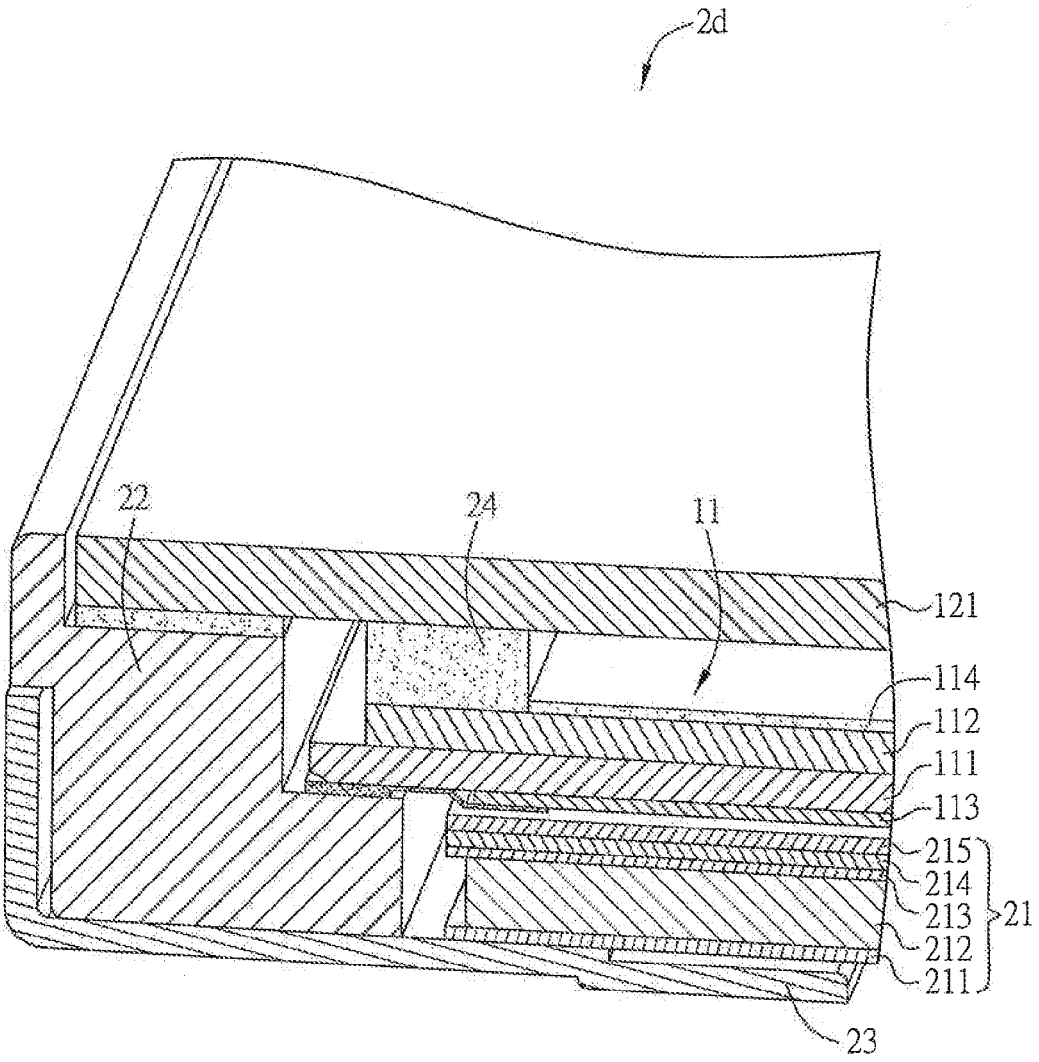


FIG. 7D

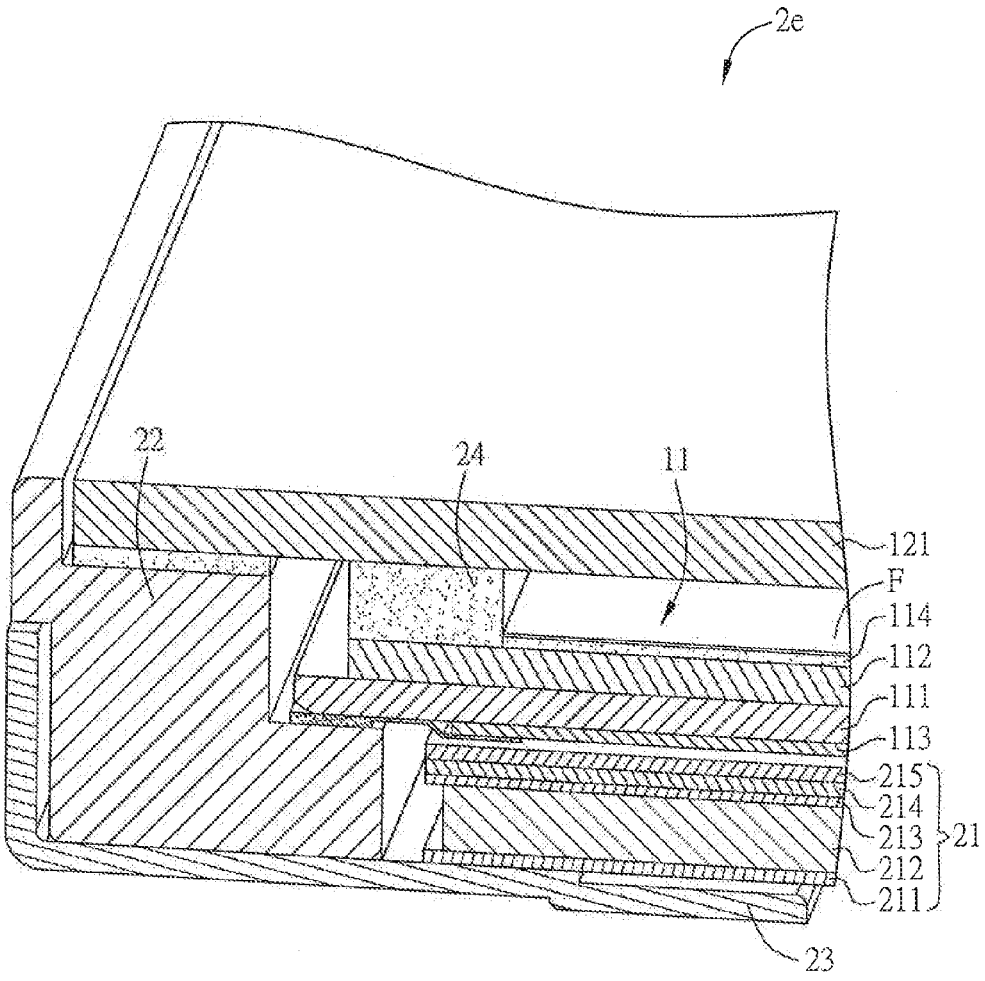


FIG. 7E

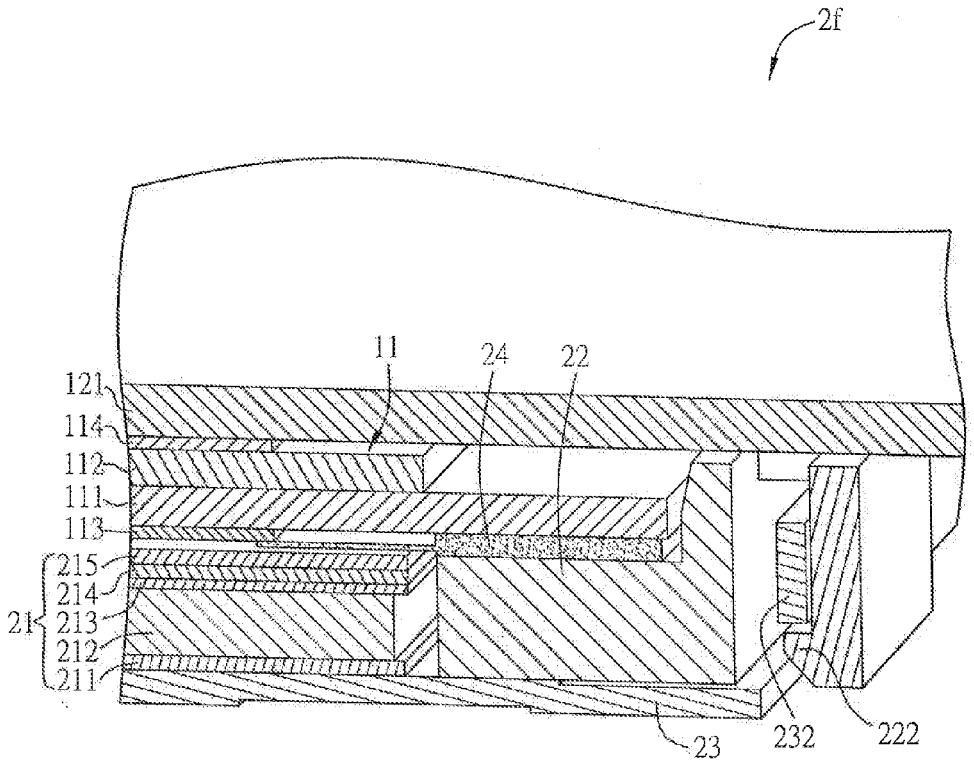


FIG. 7F

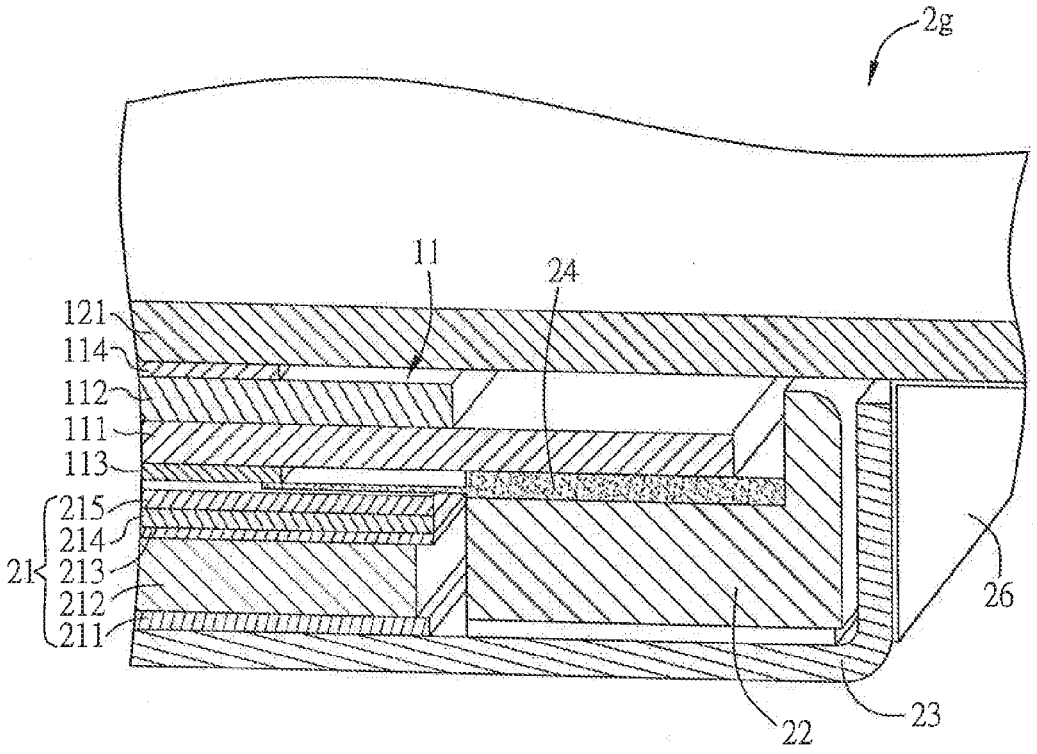


FIG. 7G

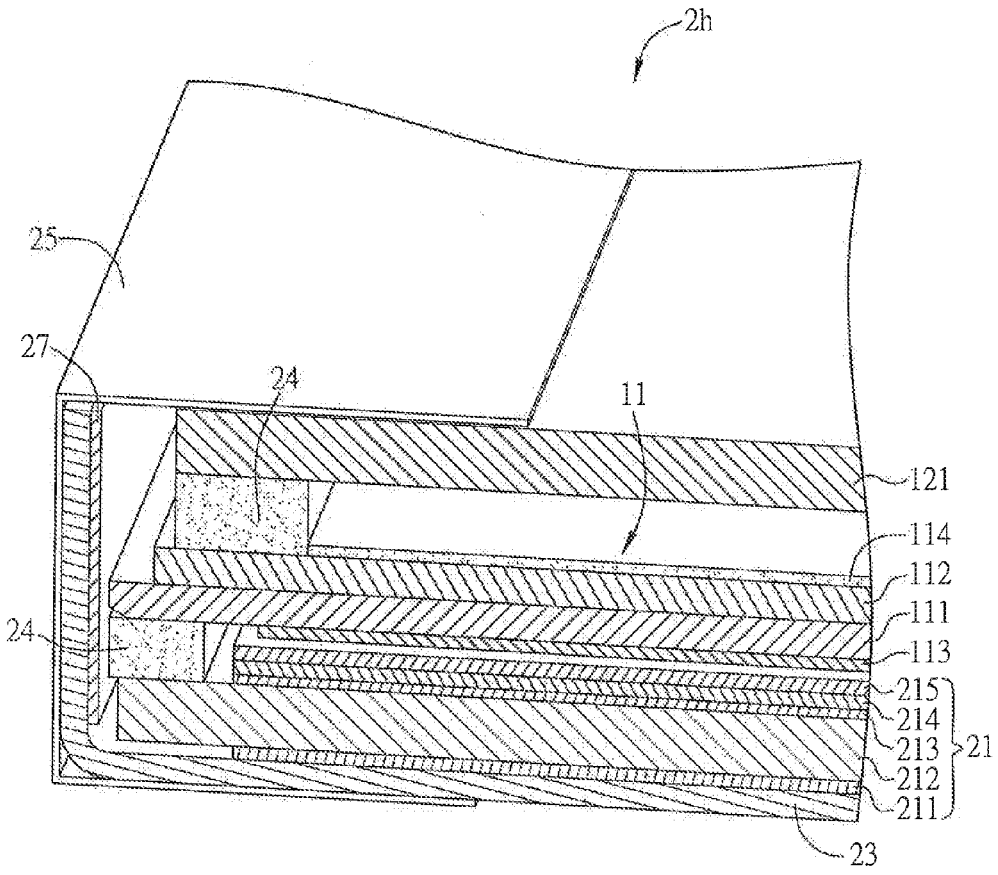


FIG.7H

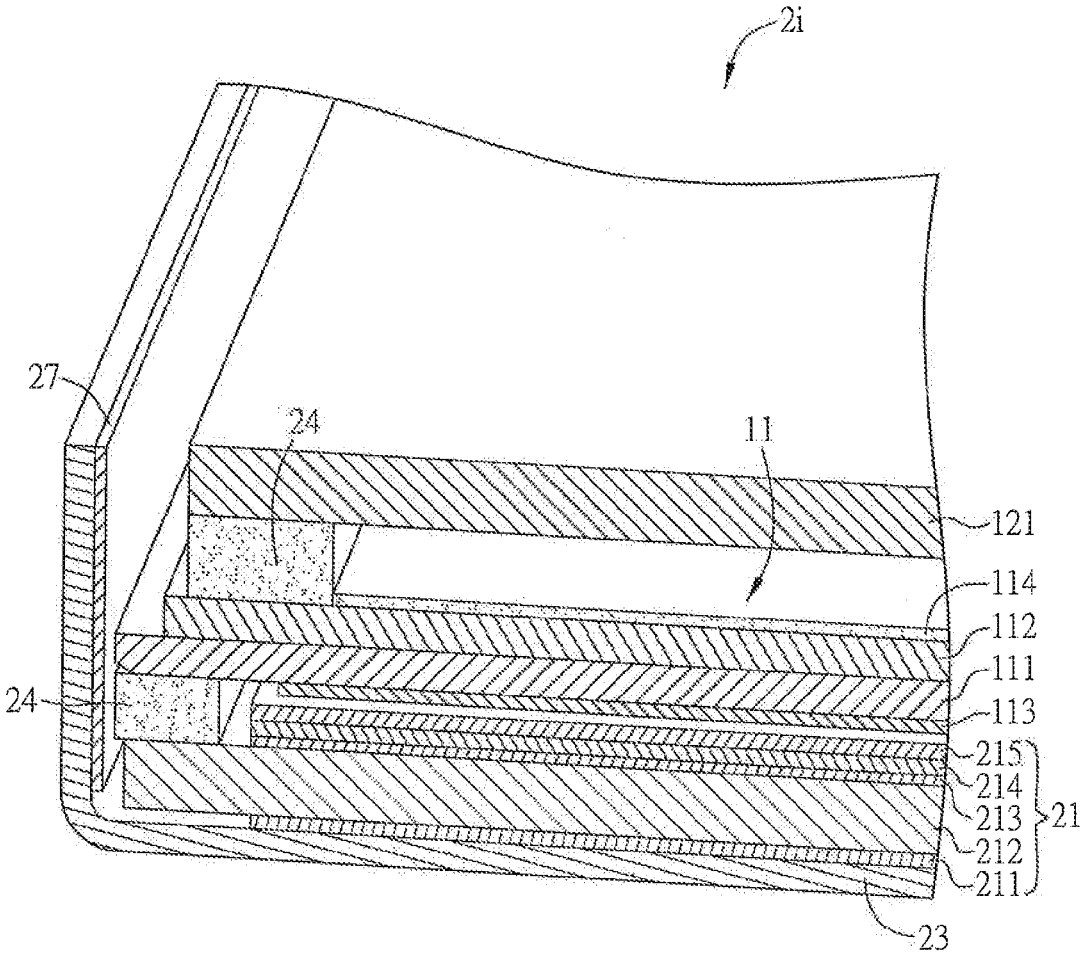


FIG. 7I

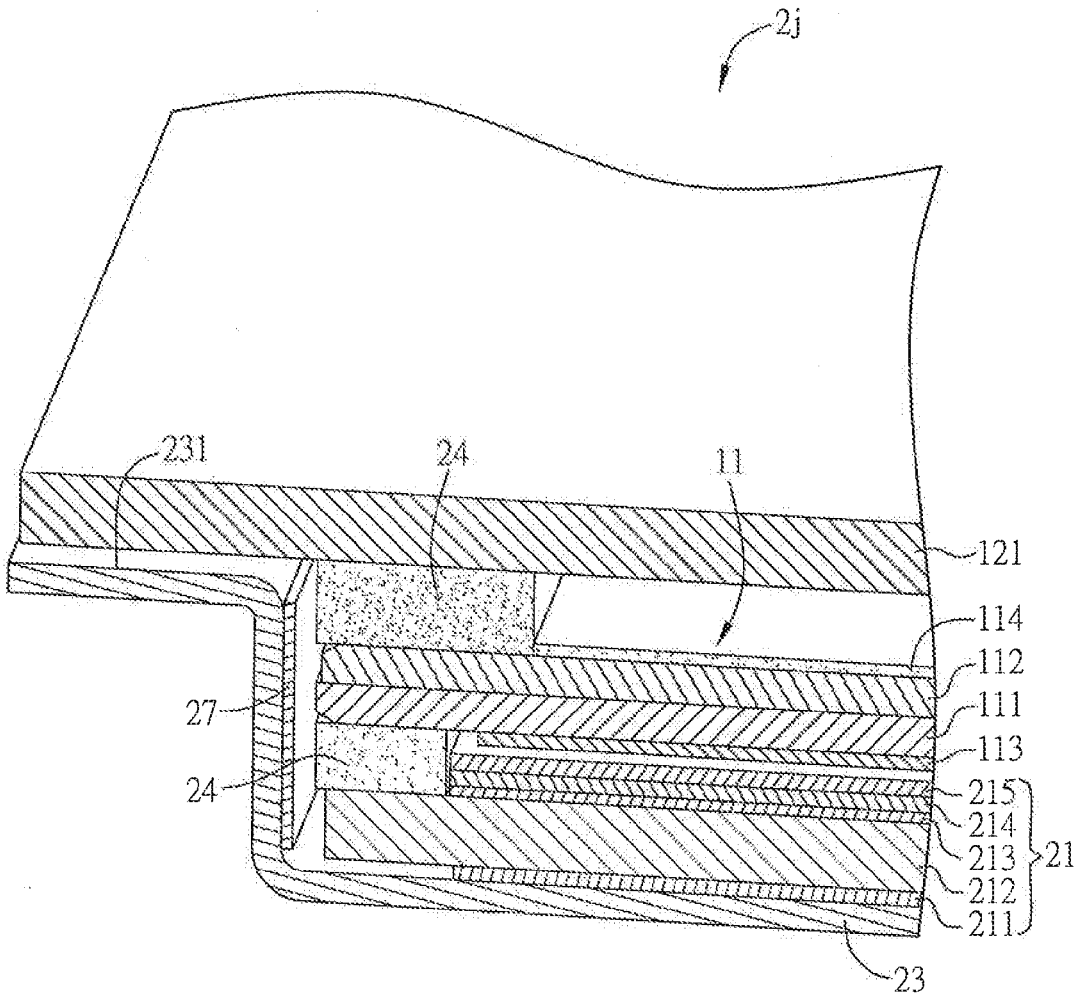


FIG. 7J

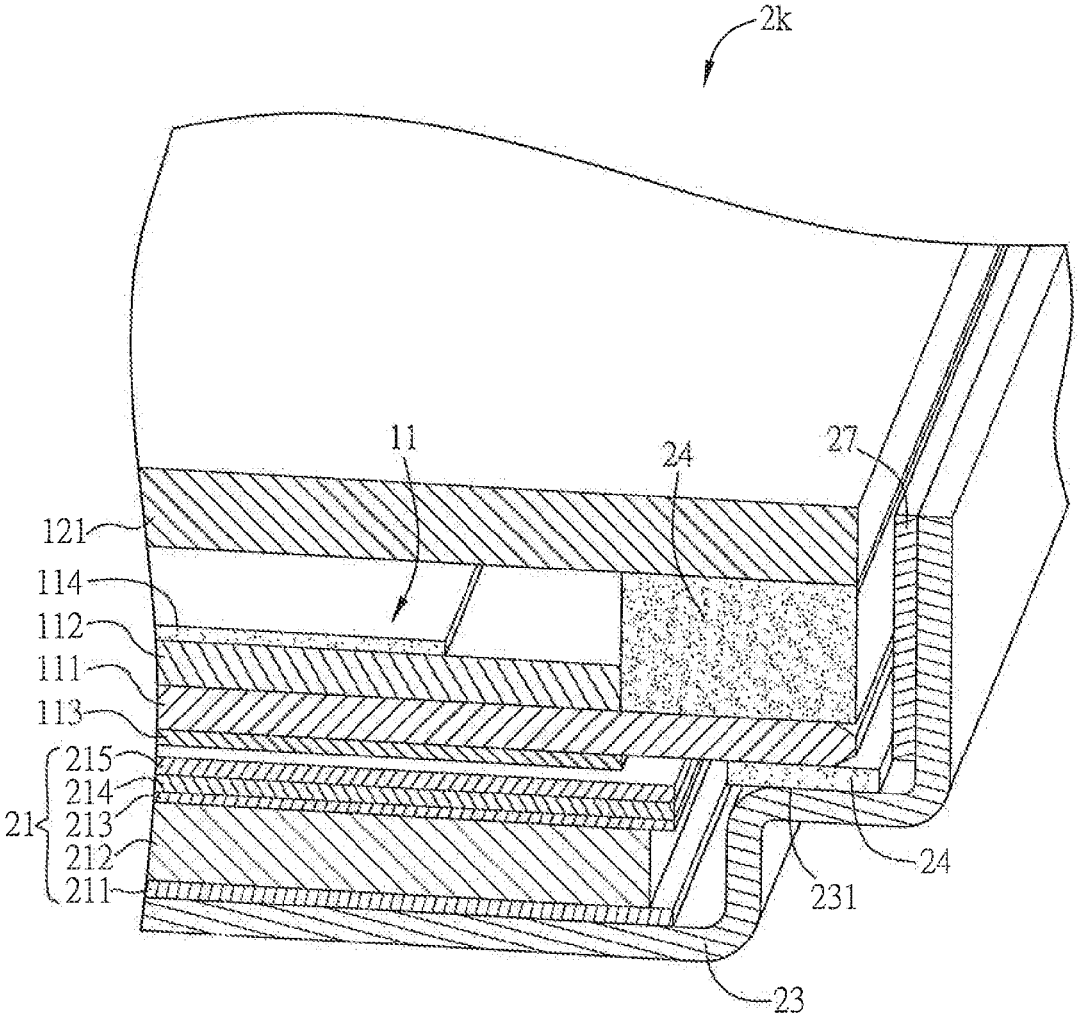


FIG. 7K

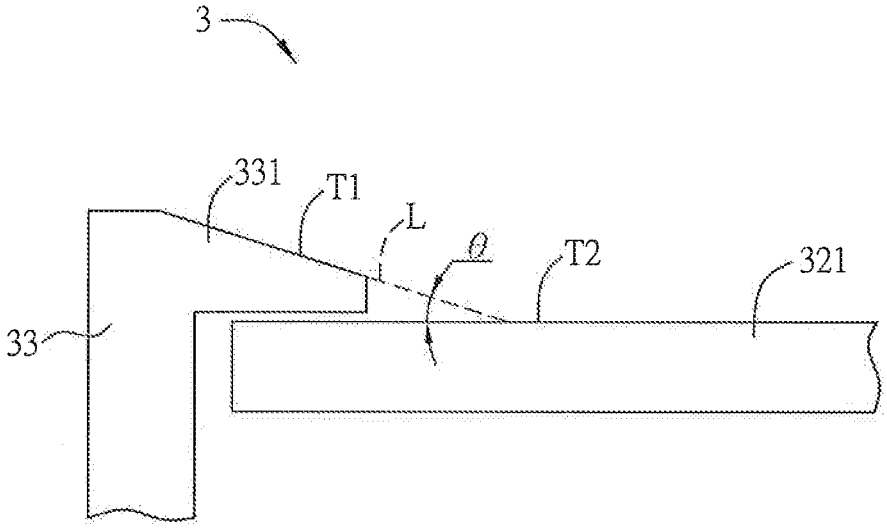


FIG. 8

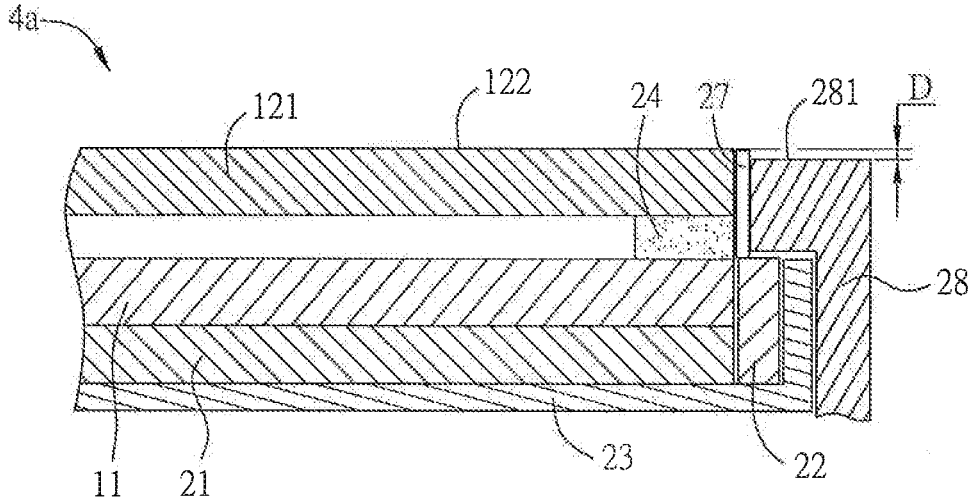


FIG. 9A

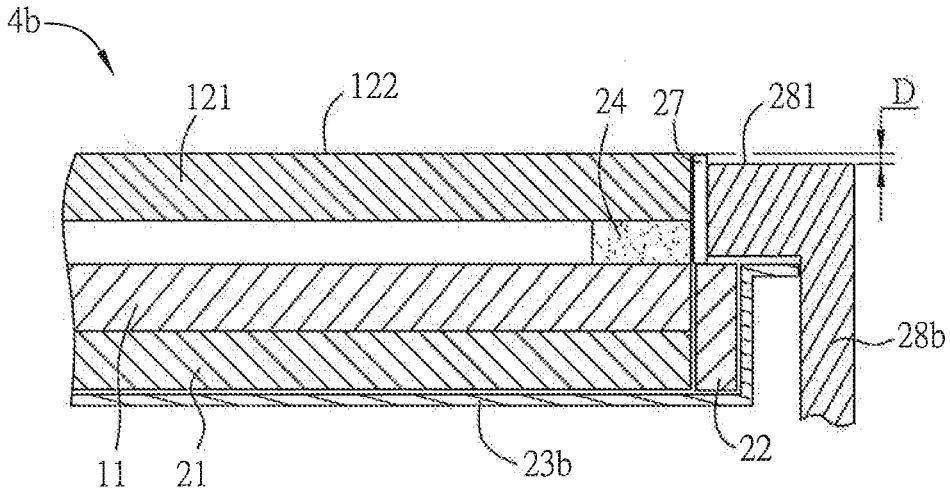

4b
121
122
24
27
281
D
28b
11
21
23b
22

FIG. 9B

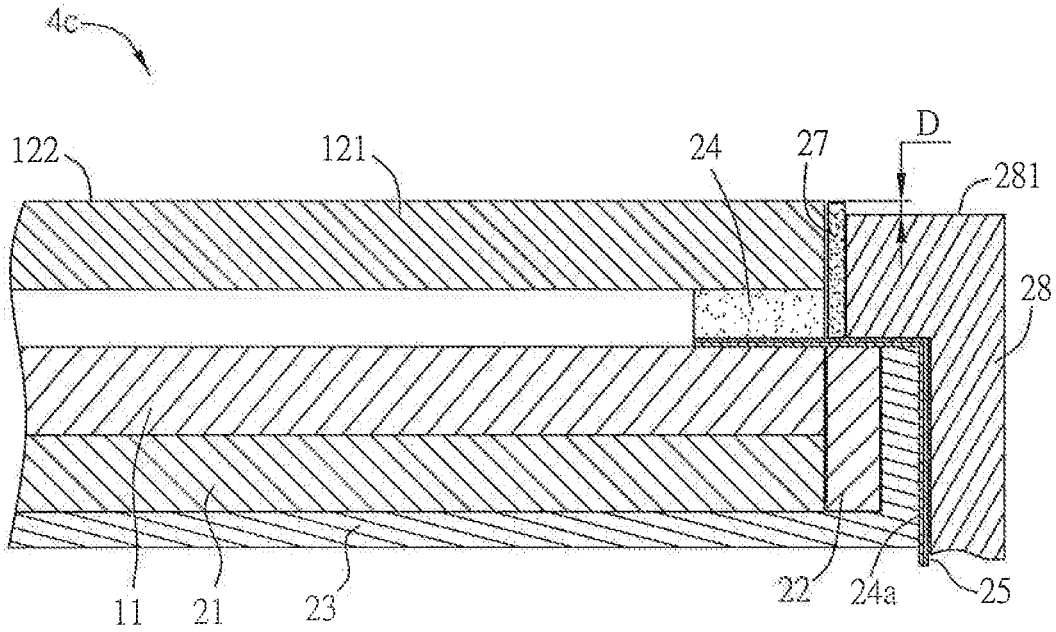

4c
122
121
24
27
D
281
28
11
21
23
22
24a
25

FIG. 9C

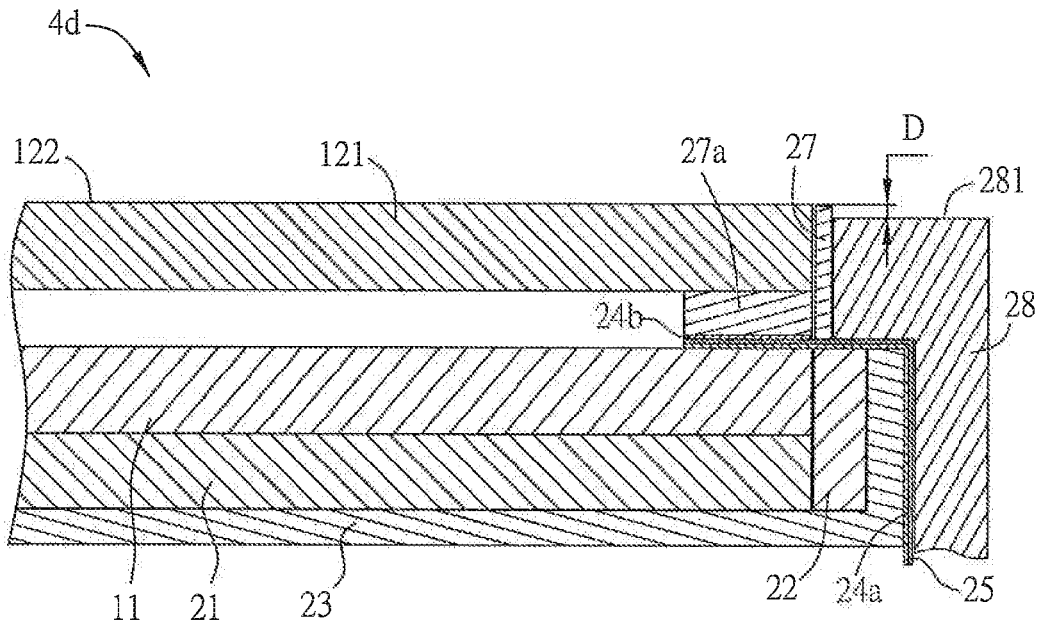


FIG. 9D

TOUCH DISPLAY APPARATUS

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the priority benefit of U.S. provisional application Ser. No. 61/804,429 filed on Mar. 22, 2013, and a Patent Application No. 102125559 filed in Taiwan on Jul. 17, 2013. The entirety of the above-mentioned patent applications is hereby incorporated by reference herein and made a part of specification.

BACKGROUND OF THE INVENTION

1. Field of Invention

The invention relates to a touch display apparatus.

2. Related Art

With the progress of technologies, various novel information apparatuses, such as cell phones, tablet computers, ultrabooks and GPS navigation apparatuses, are invented. Generally, a keyboard and mouse are commonly used to manipulate the information apparatus for inputting information. Nevertheless, the touch control technology currently also becomes a popular manipulation method for the information apparatus and brings an intuitive operation. Accordingly, a touch display apparatus using the touch control technology can provide a friendly and intuitive interface for the input operation, and therefore a user can manipulate the touch display apparatus by fingers or a stylus.

In general, the touch display apparatus can be divided into an in cell touch display apparatus and an on cell touch display apparatus. In the in cell touch display apparatus, a sensing electrode layer is disposed in a display panel (e.g. LCD panel); otherwise, in the on cell touch display apparatus, a touch panel including a sensing electrode layer is disposed on a display panel.

SUMMARY OF THE INVENTION

An objective of the invention is to provide a touch display apparatus that is with an innovative structure and advantageous for reducing the cost.

A touch display apparatus according to the invention comprises a display panel and a touch panel. The display panel includes a first substrate and a second substrate disposed oppositely. The first substrate has a first side, the second substrate has a second side corresponding to the first side, and the first side is disposed beyond the second side. The touch panel includes a touch substrate. The second substrate is disposed between the touch substrate and the first substrate, and the area of the touch substrate is less than or equal to that of the second substrate.

In one embodiment, the touch substrate has a third side, and the second substrate has a side corresponding to the third side.

In one embodiment, the third side is disposed beyond the side of the second substrate corresponding to the third side.

In one embodiment, the touch display apparatus further comprises a buffer element disposed between the touch substrate and the first substrate and adjacent to the third side of the touch substrate.

In one embodiment, the buffer element has a lengthwise direction, and along the lengthwise direction, the buffer element has a first length, the first substrate has a second length and the touch substrate has a third length. The first length is less than or equal to the second length and is larger than or equal to the third length.

In one embodiment, the touch display apparatus further comprises a circuit connection board disposed to the touch substrate and electrically connected to the touch substrate.

In one embodiment, at least a portion of the circuit connection, board overlaps the first substrate.

In one embodiment, at least a portion of the circuit connection board overlaps the second substrate.

In one embodiment, the display panel further includes an optical film which is disposed between the second substrate and the touch substrate.

In one embodiment, the touch display apparatus further comprises a backlight module, a plastic frame and a back plate. The backlight module is disposed on the side of the display panel away from the touch substrate. The plastic frame is adjacent to the backlight module, and the display panel is disposed to the plastic frame. The plastic frame and the backlight module are disposed to the back plate.

In one embodiment, the plastic frame and the back plate are connected to each other by locking or adhesion.

In one embodiment, the touch display apparatus further comprises a backlight module, an adhesive element and a back plate. The backlight module is disposed on the side of the display panel away from the touch substrate. The touch substrate and the display panel are connected to each other by the adhesive element. The backlight module is disposed to the back plate.

In one embodiment, the touch display apparatus further comprises a light blocking element extending from the back plate to the edge of the touch substrate.

In one embodiment, the touch display apparatus further comprises a front frame. The front frame is disposed at the edge of the touch substrate and includes a blocking portion, which is disposed above the touch substrate and has a surface. An angle is formed between an extension of the surface and an upper surface of the touch substrate, and the angle is between 5° and 30°.

As mentioned above, in the touch display apparatus according to the invention, the display panel includes a first substrate and a second substrate disposed opposite to each other, the first substrate has a first side, the second substrate has a second side corresponding to the first side, and the first side is disposed beyond the second side. Besides, the touch panel includes a touch substrate. The second substrate is disposed between the touch substrate and the first substrate, and the area of the touch substrate is less than that of the second substrate. Thereby, in comparison with the conventional touch display apparatus, the touch display apparatus of this invention is configured with an innovative structure and uses the smaller touch panel, and therefore the cost of the touch display apparatus can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will become more fully understood from the detailed description and accompanying drawings, which are given for illustration only, and thus are not limitative of the present invention, and wherein:

FIG. **1** is a schematic diagram of a touch display apparatus according to a preferred embodiment of the invention;

FIGS. **2**A and **2**B are schematic diagrams of the touch display apparatuses as two variations according to the preferred embodiment of the invention;

FIGS. **3**A to **3**C are schematic diagrams showing some variations of the relative position of the touch substrate, first substrate and second substrate according to this invention;

FIG. **4**A is a schematic diagram showing the integration of the driving circuit of the touch panel and the driving circuit of the display panel according to this invention;

FIGS. **4**B to **4**D are schematic diagrams of some variations of the layout of the touch display apparatus according to this invention;

FIG. **5** is a schematic perspective diagram of a touch display apparatus according to a preferred embodiment of the invention;

FIG. **6** is a schematic diagram showing another relative position of the touch substrate, first substrate and second substrate according to this invention;

FIGS. **7**A to **7**K are perspective sectional diagrams schematically showing several variations of a touch display apparatus according to a preferred embodiment of the invention;

FIG. **8** is a schematic diagram of another ouch display apparatus according to a preferred embodiment of the invention; and

FIGS. **9**A to **9**D are schematic diagrams of the touch display apparatuses as four variations according to a preferred embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention will be apparent from the following detailed description, which proceeds with reference to the accompanying drawings, wherein the same references relate to the same elements.

FIG. **1** is a schematic diagram of a touch display apparatus according to a preferred embodiment of the invention.

The touch display apparatus **1** includes a display panel **11** and a touch panel **12**.

The display panel **11** includes a first substrate **111**, a second substrate **112** and an optical film. The first substrate **111** and the second substrate **112** are disposed oppositely. The display panel **11** can be a liquid crystal display (LCD) panel or an organic light emitting diode (OLED) display panel. In this embodiment, the display panel **11** is an LCD panel for example. The materials of the first substrate **111**, second substrate **112** and touch panel **12** can include glass, and they can be made by the same or different glass. In this embodiment, the area of the second substrate **112** is, for example, less than that of the first substrate **111**.

In this embodiment, the first substrate **111** is a thin film transistor (TFT) substrate, and the second substrate **112** is a color filter (CF) substrate, for example. However, in other embodiments, the black matrix layer or filter layer of the color filter substrate also can be removed to the TFT substrate, and thus the first substrate **111** becomes a BOA (BM on array) substrate or COA (color filter on array) substrate. However, the invention is not limited thereto. Besides, the display panel **11** can further include a liquid crystal layer (not shown), which is disposed between the first and second substrates **111** and **112**.

The touch panel **12** includes a touch substrate **121**, and the second substrate **112** is disposed between the touch substrate **121** and the first substrate **111**. Herein, a control IC for controlling the touch panel **12** is not disposed on the touch substrate **121**. The display panel **11** has two optical films **113** and **114** for example. Herein, the optical film **113** is a lower polarization plate and the optical film **114** is an upper polarization plate. The optical film **113** is disposed on the side of the first substrate **111** away from the second substrate **112**, and the optical film **114** is disposed between the second substrate **112** and the touch panel **12**. Herein, the optical film **113** is disposed on the lower surface of the first substrate **111**, and the optical film **114** is disposed on the upper surface of the second substrate **112**. However, such configuration can be varied in other embodiments. For example, if the display panel **11** is an OLED display panel, only one optical film is required, and it can be, for example but is not limited to, a ¼λ circular polarizer, polarizer or anti-reflection film and is disposed between the second substrate **112** and the touch panel **12**.

The area of the optical film **113** is less than that of the first substrate **111**, and the area of the optical film **114** is less than that of the second substrate **112**. However, in other embodiments, the area of the optical film **113** can be equal to that of the first substrate **111**, and the area of the optical film **114** can be equal to that of the second substrate **112**.

The touch panel **12** (touch substrate **121**) is disposed opposite the display panel **11** and above the second substrate **112**, and can be connected to second substrate **112** by adhesion or other connection methods. The touch substrate **121** and the optical film **114** can be connected to each other by an adhesive element (not shown) in a direct bonding way for example. Otherwise, the touch substrate **121** and the optical film **114** don't contact each other, but the touch panel **12** and the display panel **11** are connected to each other in an air bonding way. As to the air bonding, an adhesive element is annularly disposed on the four edges or just a portion of the edges of the upper surface of the second substrate **112**, or is disposed in a paste dispensing way, for connecting the touch substrate **121** and the display panel **11**. Since the optical film **114** is less than the second substrate **112** in area and is disposed between the second substrate **112** and the touch substrate **121** so as to be surrounded by the adhesive element, a gap is formed between the optical film **114** and the touch substrate **121**. Besides, the area of the touch substrate **121** is less than or equal to that of the second substrate **112**. In this embodiment, the area of the touch substrate **121** is less than that of the second substrate **112** for example. Besides, in this embodiment, the area of the second substrate **112** is less than that of the first substrate **111**.

The first substrate **111** has a first side S**1**, and the second substrate **112** has a second side S**2** that is corresponding to the first side S**1**. The first side S**1** of the first substrate **111** is disposed beyond the second side S**2** of the second substrate **112**. Besides, the relationship between the other sides of the first substrate **111** and their corresponding sides of the second substrate **112** is not limited in the invention. For example, one of the other sides of the first substrate **111** can go beyond, fail short of, or align with its corresponding side of the second substrate **112**.

The first side S**1** of the first substrate **111** is disposed beyond the second side S**2** of the second substrate **112**. A side of the touch panel **12** is disposed beyond the corresponding side of the optical film **114** by a length A between 0 and 10 mm for example. Besides, the first side S**1** of the first substrate **111** is disposed beyond the corresponding side of the optical film **114** by a length B, and the length B is not more than 10 mm. The distance C between the touch substrate **121** and the optical film **114** can be between 0 and 0.3 mm. Since the gap (distance C) between the touch substrate **121** and the optical film **114** is extremely small, the deformation of the touch substrate **121** caused by the touch control can be less than the prior art. Besides, the display panel **11** can be thus considered to support the touch substrate **121** at a certain level, and therefore the touch panel **12** is unnecessary to be further treated with a strengthening process.

FIGS. **2**A and **2**B are schematic diagrams of the touch display apparatuses **1***a* and **1***b* as two variations according to the preferred embodiment of the invention.

As shown in FIG. **2**A, mainly different from the touch display apparatus **1**, the touch display apparatus **1***a* further includes a circuit connection board **13**, which is disposed on and bonded to the touch substrate **121** for the mutual electrical connection. Herein, the circuit connection board **13** is connected to the lower surface of the touch substrate **121** to be electrically connected to the touch substrate **121**. Besides, at least a portion of the circuit connection board **13** overlaps the first substrate **111**. In other words, for a top view of the touch panel **12**, at least a portion of the circuit connection board **13** overlaps the first substrate **111**. A driving circuit for driving the touch panel **12** is electrically connected to the circuit connection board **13** so as to control the touch panel **12** through the circuit connection board **13**. Herein, the circuit connection board **13** is, for example but not limited to, a flexible printed circuit (FPC) board or rigid-flex board.

Besides, at least a portion of the circuit connection board **13** overlaps the second substrate **112**. In this embodiment, the circuit connection board **13** overlaps both of the first and second substrates **111** and **112**. Furthermore, the circuit connection board **13** doesn't overlap the optical film **114**. Therefore, the gap between the touch substrate **121** and the second substrate **112** can be kept smaller. Because the circuit connection board **13** doesn't overlap the optical film **114** but overlaps the first substrate **111**, the connection area between the touch substrate **121** and the circuit connection board **13** can be increased and thus the total dimensions thereof can be reduced.

As shown in FIG. **2**B, mainly different from the touch display apparatus **1***a*, for a top view of the touch display apparatus **1***b*, the circuit connection board **13** just overlaps the first substrate **111** but has no overlap with the second substrate **112**.

FIGS. **3**A to **3**C are schematic diagrams showing some variations of the relative position of the touch substrate **121**, first substrate **111** and second substrate **112** according to this invention.

As shown in FIG. **3**A, the touch substrate **121** is disposed over the display panel (including the first and second substrates **111** and **112**), and is disposed beyond at least an edge of the display panel. Herein, the area of the second substrate **112** is less than that of the first substrate **111**. The four sides of the touch substrate **121** are not aligned with those of the first substrate ill, respectively. The two sides (left and top sides) of the second substrate **112** are aligned with the corresponding sides of the first substrate **111**, respectively. In this embodiment, the circuit connection board **13** is located at the left and top sides of the touch substrate **121** in FIG. **3**A. Otherwise, the circuit connection board **13** can be disposed at the right and bottom sides of the touch substrate **121** of FIG. **3**A. At least one of the sides of the second substrate **112** is disposed between the first substrate **111** and the touch substrate **121**. Herein for example, the two sides (right and bottom sides) of the second substrate **112** are located between the corresponding sides of the first substrate **111** and the touch substrate **121**, respectively. Besides, the first side S**1** of the first substrate **111** is disposed beyond the corresponding side (second side S**2**) of the second substrate **112**.

As shown in FIG. **3**B, the touch substrate **121** is disposed over the display panel (including the first and second substrates **111** and **112**). The four sides of the touch substrate **121** are not aligned with those of the first and second substrates **111** and **112**, respectively. The two sides (left and top sides) of the second substrate **112** are aligned with the corresponding sides of the first substrate **111**, respectively. The area of the second substrate **112** is less than that of the first substrate **111**.

As shown in FIG. **3**C, the touch substrate **121** is disposed over the display panel (including the first and second substrates **111** and **112**), and is disposed beyond the display panel. The four sides of the touch substrate **121** are not aligned with those of the first and second substrates **111** and **112**, respectively. The two sides (left and top sides) of the second substrate **112** are aligned with the corresponding sides of the first substrate **111**, respectively. Besides, the second substrate **112** has a fourth side S**4** that is corresponding to a third side S**3** of the touch substrate **121**, and the third side S**3** of the touch substrate **121** is disposed beyond the fourth side S**4** of the second substrate **112**. The area of the second substrate **112** is less than that of the first substrate **111**. The circuit connection board **13** is disposed at the third and bottom sides of the touch substrate **121** in FIG. **3**C.

FIG. **4**A is a schematic diagram showing the integration of the driving circuit of the touch panel **12** and the driving circuit of the display panel **11** according to this invention.

The display panel **11** can be electrically connected to a driving circuit board **115** through a circuit film **116** (e.g. chip on film, COF), and the touch panel **12** (touch substrate **121**) can be electrically connected to the driving circuit board **115** through the circuit connection board **13** and a connection element C**1**. Therefore, the driving circuits of the display panel **11** and touch panel **12** can be integrated to the same driving circuit board **115**.

FIGS. **4**B to **4**D are schematic diagrams of some variations of the layout of the touch display apparatus **1** according to this invention. Herein, the touch display apparatus **1** is taken as an example, but the touch display apparatuses **1***a* and **1***b* also can be applied in this manner.

The touch display apparatus **1** has a viewable area V. The viewable area V denotes the area which the light can pass through to cause images for the user. Herein, the driving circuits of the display panel **11** (not shown) and touch panel **12** (not shown) of the touch display apparatus **1** are integrated to the same driving circuit board **115**.

As shown in FIG. **4**B, the driving circuit board **115** is electrically connected to the touch display apparatus **1** through a connection element C**1**, a circuit connection board **13** and a plurality of wires C**2**. As shown in FIG. **4**C, the driving circuit board. **115** is electrically connected to the touch display apparatus **1** through two connection elements C**1**, two circuit connection boards **13** and a plurality of wires C**2**. As shown in FIG. **4**D, the driving circuit board **115** is electrically connected to the touch display apparatus **1** through two connection elements C**1**, a circuit connection board **13** and a plurality of wires C**2**.

FIG. **5** is a schematic perspective diagram of a touch display apparatus according to a preferred embodiment of the invention. The optical film **113** is not shown in FIG. **5**.

The touch substrate **121** overlaps the display panel **11**. The first substrate **111** is located at a lower place, and the second substrate **112** is disposed above the first substrate **111**. The first side S**1** of the first substrate **111** is disposed beyond the second side S**2** of the second substrate **112**. The area of the second substrate **112** is less than that of the first substrate **111**. The area of the touch substrate **121** is less than that of the second substrate **112**. Between the touch substrate **121** and the second substrate **112** is the optical film **114**, and the area of the optical film **114** is less than that of each of the touch substrate **121** and the second substrate **112**. The circuit

connection board **13** is connected to the touch substrate **121**, and overlaps the first and second substrates **111** and **112** for a top view.

FIG. **6** is a schematic diagram showing another relative position of the touch substrate **121**, first substrate **111** and second substrate **112** according to this invention.

In this embodiment, the third side S**3** (left side) is disposed beyond the corresponding side (fourth side S**4**) of the second substrate **112**. The touch display apparatus further includes a buffer element BE, which is disposed between the touch substrate **121** and the first substrate **111** and is adjacent to the third side S**3** and fourth side S**4**. Therefore, the buffer element BE can provide a buffer between the first substrate **111** and the touch substrate **121**. The buffer element BE has a lengthwise direction X. Along the lengthwise direction X, the buffer element BE has a first length L**1**, the first substrate **111** has a second length L**2**, and the touch substrate **121** has a third length L**3**. The first length L**1** is less than or equal to the second length L**2**, and is larger than or equal to the third length L**3**. Herein, the third length L**3** is less than the first length L**1** while the first length L**1** is less than the second length L**2**.

FIGS. **7**A to **7**K are perspective sectional diagrams schematically showing several variations of a touch display apparatus according to a preferred embodiment of the invention. The circuit connection board **13** is directly connected to the touch substrate **121** to achieve the mutual electrical connection. Besides, the circuit connection board **13** can be electrically connected to the driving circuit board of the touch substrate **121** via the through hole of the adhesive element or plastic frame. The circuit connection board **13** is disposed over the first substrate **111**, and that means at least a portion of the circuit connection board **13** overlaps the display panel **11**. However, the circuit connection board **13** is not shown in FIGS. **7**A to **7**K. Besides, FIGS. **7**B to **7**G, and **7**J to **7**K show the cases of the touch substrate **121** disposed beyond at least an edge of the display panel **11**.

As shown in FIG. **7**A, the touch display apparatus **2***a* includes a touch panel **11**, a display panel **12** and a backlight module **21**. The touch panel **11** and display panel **12** are clearly illustrated in the above embodiments, and therefore they are not described here for conciseness.

The backlight module **21** is disposed on the side of the display panel **11** away from the touch substrate **121**, and can emit the light to the display panel **11** so that the display panel **11** can display images. In this embodiment, the backlight module **21** includes a reflective plate **211**, alight guiding plate **212** and a plurality of optical films **213**, **214**, **215**. The optical films **213** to **215** are, for example but not limited to, a light concentrating plate or diffusion plate each. Since the backlight module **21** belongs to the prior art and can be known by those skilled in the art, it is not described here for conciseness.

The touch display apparatus **2***a* further includes a plastic frame **22** and a back plate **23**. The display panel **11** is disposed to the plastic frame **22**. The plastic frame **22** can support the display panel **11**, and thus the display panel **11** is disposed opposite the backlight module **21**. Herein, the plastic frame **22** is adjacent to the backlight module **21**. The display panel **11** and the touch substrate **121** are disposed on the plastic frame **22**, so that the first substrate **111**, second substrate **112** and touch substrate **121** are supported by a supporting surface **1** of the plastic frame **22**. Besides, the back plate **23** can accommodate the display panel **11**, touch substrate backlight module **21** and plastic frame **22**, and can provide protection for the collision, electromagnetic wave or electric shock. The back plate **23** can be made by plastic material, metal or alloy, but this invention is not limited thereto.

In this embodiment, the area of the touch substrate **121** is less than that of the second substrate **112**, and the first substrate **111** is disposed beyond at least an edge of the second substrate **112**. In other embodiments, the area of the touch substrate **121** can be equal to that of the second substrate **112**. The touch substrate **121** and the display panel **11** are connected to each other by air bonding. Herein, the touch display apparatus **2***a* further includes an adhesive element **24**, which is disposed on the edge of the upper surface of the second substrate **112** to adhere to the touch substrate **121** and second substrate **112**. The adhesive element **24** can be disposed annularly or in a paste dispensing way. In a paste dispensing way can reduce the cost, and the annular disposition can provide a better connection effectiveness. The optical film **114** is less than the second substrate **112** in area, and is surrounded by the adhesive element **24**. A gap is kept between the optical film **114** and the touch substrate **121**. In other embodiments, an optical film (not shown) can be disposed within the gap for increasing the light output efficiency of the touch display apparatus **2***a*.

The touch display apparatus **2***a* can further include a light blocking element **25**. The light blocking element **25** is, for example but not limited to, a light blocking adhesive tape, and extends from the back plate **23** to the edge of the touch substrate **121** for blocking the undesired side light and providing a fixing function. Herein, the light blocking element **25** adheres to the back plate **23** and covers the partial touch substrate **121**, the plastic frame **22**, and an edge and partial bottom of the back plate **23**.

As shown in FIG. **7**B, mainly different from the touch display apparatus **2***a*, the touch substrate **121** of the touch display apparatus **2***b* is disposed beyond an edge of the display panel **11**, and the shape of the plastic frame **22** is changed accordingly to limit the lateral movements of the touch substrate **121** and display panel **11**. Besides, another adhesive element **24** is disposed between the plastic frame **22** and the touch substrate **121** and adheres to the supporting surface **221** of the plastic frame **22** for fixing the touch substrate **121**.

As shown in FIG. **7**C, mainly different from the touch display apparatus **2***b* in FIG. **7**B, the touch display apparatus **2***c* doesn't include the light blocking element **25** of FIG. **7**B. Besides, the plastic frame **22** of the touch display apparatus **2***c* is slightly different from that of FIG. **7**B in shape.

As shown in FIG. **7**D, mainly different from the touch display apparatus **2***b* in FIG. **7**B, the touch display apparatus **2***c* doesn't include the light blocking element **25** of FIG. **7**B.

As shown in FIG. **7**E, mainly different from the touch display apparatus **2***d* in FIG. **7**D, the touch display apparatus **2***e* further includes an optical film F. The optical film F is disposed between the second substrate **112** and the touch substrate **121** and connected to the optical film **114** for reflecting and returning the light to the touch substrate **121** in order to increase the light output efficiency. The optical film F is made by the material with high reflectance, and can be an anti-reflection film for example.

As shown in FIG. **7**F, mainly different from the touch display apparatus **2***c* in FIG. **7**C, the touch substrate **121** and the display panel **11** of the touch display apparatus **2***f* are connected to each other by a direct bonding (the adhesive element therebetween is not shown). The area of the second substrate **112** is less than that of the first substrate **111**, and the area of the touch substrate **121** is less that that of the

second substrate **112**. Besides, the touch substrate **121** is disposed beyond the edges of the first and second substrates **111** and **112**. The plastic frame **22** in FIG. **7**F has a hook portion **222**, and the hook portion **222** and a locking portion **232** of the back plate **23** are locked by each other.

As shown in FIG. **7**G, mainly different from the touch display apparatus **2***f* in FIG. **7**F, the plastic frame **22** of the touch display apparatus **2***g* in FIG. **7**G has no hook portion, and the back plate **23** and the touch substrate **121** are fixed together by an adhesive tape **26**.

In comparison with the cases of FIGS. **7**A to **7**G, the cases of FIGS. **7**H to **7**K are designed as no plastic frame, and the adhesive element **24** adheres to, supports or connects to the display panel and the touch substrate **121**.

As shown in FIG. **7**H, the touch substrate **121** and display panel **11** of the touch display apparatus **2***h* are connected to each other by an air bonding, and thus the adhesive element **24** connects to the touch substrate **121** and the display panel **11**. The area of the touch substrate **121** is less than that of the second substrate **112**, and the area of the second substrate **112** is less than that of the first substrate **111**. In other embodiments, the area of the touch substrate **121** can be equal to that of the second substrate **112**, and the area of the second substrate **112** can be equal to that of the first substrate **111**. Besides, another adhesive, element **24** is disposed between the display panel **11** and the light guiding plate **212** of the backlight module **21**, and adheres to and supports them. Furthermore, a buffer pad **27** is disposed among the back plate **23**, backlight module **21**, display panel **11** and touch substrate **121**, and can absorb the vibration and installation tolerance of the backlight module **21**, display panel **11** and touch substrate **121** disposed to the back plate **23**. Because this embodiment is designed as no plastic frame, the touch substrate **121**, display panel **11** and backlight module **21** are connected and fixed by the adhesive element **24**.

As shown in FIG. **7**I, mainly different from the touch display apparatus **2***h* in FIG. **7**H, the touch display apparatus **2***i* has no light blocking element **25** of FIG. **7**H.

In FIG. **7**J, a side of the substrate **111** aligned with its corresponding side of the second substrate **112** is shown, and another side of the substrate **111** disposed beyond its corresponding side of the second substrate **112** is not shown.

Mainly different from the touch display apparatus **2***i* in FIG. **7**I, the touch substrate **121** of the touch display apparatus **2***j* is disposed beyond the edges of the first and second substrates **111** and **112**, and the back plate **23** is changed accordingly in shape. Thus, the touch substrate **121** is supported by a supporting surface **231** of the back plate **23**.

As shown in FIG. **7**K, mainly different from the touch display apparatus **2***j* in FIG. **7**J, the shape of the back plate **23** of the touch display apparatus **2***k* is changed according to the position of the first substrate **111** and touch substrate **121**, and thus the back plate **23** supports and adheres to the first substrate **111** by the supporting surface **231** and another adhesive element **24**.

FIG. **8** is a schematic diagram of another touch display apparatus **3** according to a preferred embodiment of the invention. As shown in FIG. **8**, the touch display apparatus **3** can be one of the touch display apparatuses **2***a*~**2***k*. Except the touch substrate **321**, other components of the touch display apparatus in the above-mentioned embodiments are not shown in FIG. **8**.

The touch display apparatus **3** can further include a front frame **33**, which is disposed at the edge of the touch substrate **321** but uncovers the viewable area. Herein, the front frame **33** includes a blocking portion **331**, which is disposed above the touch substrate **321** and covers an outer edge of the touch substrate **321**. The blocking portion **331** has a surface T**1**, and an angle θ is formed between an extension L of the surface T**1** and an upper surface T**2** of the touch substrate **321**. The angle θ can be between 5° and 30°.

FIGS. **9**A to **9**D are schematic diagrams of the touch display apparatuses **4***a*~**4***d* as four variations according to a preferred embodiment of the invention. In FIGS. **9**A to **9**D, a side of the touch substrate **121** aligned with the corresponding sides of the first and second substrates **111** and **112** is shown, and the first side of the substrate **111** disposed beyond the second side of the second substrate **112** is not shown.

As shown in FIG. **9**A, the touch substrate **121** and the display panel **11** are connected to each other by an air bonding (via the adhesive element **24**). Besides, the touch substrate **121**, display panel **11** and backlight module **21** are disposed inside the back plate **23**.

The touch display apparatus **4***a* further includes an appearance element **28**, which is disposed around the touch substrate **121**, display panel **11** and backlight module **21**. Herein, in consideration of the touch substrate **121**, display panel **11** and backlight module **21**, this case is a so-called borderless design. A top surface **281** of the appearance element **28** can be lower than, as high as, or higher than a surface **122** of the touch substrate **121**. Herein, the surface **122** is the upper surface and can be regarded as a touch surface. In other words, the top surface **281** of the appearance element **28** and the surface **122** of the touch substrate **121** can have no height difference or a height difference D that is between 0 and 1 mm and preferably between 0 and 0.5 mm. In this embodiment, the top surface **281** of the appearance element **28** is lower than the surface **122** of the touch substrate **121** by a height difference D of 1 mm at most. In other embodiments, if the top surface **281** of the appearance element **28** is higher than the surface **122** of the touch substrate **121**, the height difference D is also 1 mm at most.

As shown in FIG. **9**B, mainly different from the touch display apparatus **4***a*, the back plate **23***b* of the touch display apparatus **4***b* has a different shape from the back plate **23**, and accordingly the shape of the appearance element **28***b* is different from the appearance element **28**. However, the height difference D between the top surface **281** of the appearance element **28***b* and the surface **122** of the touch substrate **121** is still between 0 and 1 mm. Other technical features of the touch display apparatus **4***b* can be known by referring to the touch display apparatus **4***a*, and therefore they are not described here for conciseness.

As shown in FIG. **9**C, mainly different from the touch display apparatus **4***a*, the touch display apparatus **4***c* includes a light blocking element **25** which is disposed outside the back plate **23** and extends to the upper surface of the display panel **11** for blocking the undesired side light. Besides, another adhesive element **24***a* is disposed between the light blocking element **25** and the back plate **23** and between the light blocking element **25** and the display panel **11**. By the adhesive elements **24** and **24***a*, the touch substrate **121** and the display panel **11** can be fixed to each other for avoiding the lateral relative movement therebetween. Other technical features of the touch display apparatus **4***c* can be known by referring to the touch display apparatus **4***a*, and therefore they are not described here for conciseness.

As shown in FIG. **9**D, mainly different from the touch display apparatus **4***c*, the touch display apparatus **4***d* doesn't include the adhesive element **24** but includes a buffer pad **27***a* which is disposed between the touch substrate **121** and the display panel **11**. Since the buffer pad **27***a* is disposed

between the touch substrate **121** and the display panel **11**, an adhesive element **24***b* is additionally disposed between the buffer pad **27***a* and the light blocking element **25** for fixing the touch substrate **121** and the display panel **11** to each other. By the adhesive elements **24***a* and **24***b*, the touch substrate **121** and the display panel **11** can be fixed to each other for avoiding the lateral relative movement therebetween. The adhesive elements **24***a* and **24***b* can use the same or different material according to the adhesive targets (e.g. the buffer pad **27***a* with the light blocking element **25**, or the light blocking element **25** with the display panel **11** and back plate **23**). Other technical features of the touch display apparatus **4***d* can be known by referring to the touch display apparatus **4***c*, and therefore they are not described here for conciseness.

In summary, in the touch display apparatus according to the invention, the display panel includes a first substrate and a second substrate disposed opposite to each other, the first substrate has a first side, the second substrate has a second side corresponding to the first side, and the first side is disposed beyond the second side. Besides, the touch panel includes a touch substrate. The second substrate is disposed between the touch substrate and the first substrate, and the area of the touch substrate is less than that of the second substrate. Thereby, in comparison with the conventional touch display apparatus, the touch display apparatus of this invention is configured with an innovative structure and uses the smaller touch panel, and therefore the cost of the touch display apparatus can be reduced.

Although the invention has been described with reference to specific embodiments, this description is not meant to be construed in a limiting sense. Various modifications of the disclosed embodiments, as well as alternative embodiments, will be apparent to persons skilled in the art. It is, therefore, contemplated that the appended claims will cover all modifications that fall within the true scope of the invention.

What is claimed is:

1. A touch display apparatus, comprising:

a display panel including a first substrate and a second substrate disposed oppositely, wherein the first substrate has a first side, the second substrate has a second side corresponding to the first side, and the first side is disposed beyond the second side;

a touch panel, including a touch substrate, wherein the second substrate is disposed between the touch substrate and the first substrate, and the area of the touch substrate is less than or equal to that of the second substrate, wherein the touch substrate has a third side, and the second substrate has a side corresponding to the third side, and the third side is disposed beyond the side of the second substrate corresponding to the third side; and

a buffer element disposed between the touch substrate and the first substrate and adjacent to the third side of the touch substrate, wherein the buffer element has a lengthwise direction, and along the lengthwise direction, the buffer element has a first length, the first substrate has a second length and the touch substrate has a third length, and the first length is less than or equal to the second length and is larger than or equal to the third length.

2. The touch display apparatus as recited in claim **1**, further comprising:

a circuit connection board disposed to the touch substrate and electrically connected to the touch substrate.

3. The touch display apparatus as recited in claim **2**, wherein the circuit connection board and the first substrate at least partially overlap each other on a projected plane parallel to the first substrate.

4. The touch display apparatus as recited in claim **2**, wherein the circuit connection board and the second substrate at least partially overlap each other on a projected plane parallel to the second substrate.

5. The touch display apparatus as recited in claim **1**, wherein the display panel further includes an optical film which is disposed between the second substrate and the touch substrate.

6. The touch display apparatus as recited in claim **1**, further comprising:

a backlight module disposed on the side of the display panel away from the touch substrate;

a plastic frame adjacent to the backlight module, wherein the display panel is disposed to the plastic frame; and

a back plate, wherein the plastic frame and the backlight module are disposed to the back plate.

7. The touch display apparatus as recited in claim **6**, wherein the plastic frame and the back plate are connected to each other by locking or adhesion.

8. The touch display apparatus as recited in claim **1**, further comprising:

a backlight module disposed on the side of the display panel away from the touch substrate;

an adhesive element by which the touch substrate and the display panel are connected to each other; and

a back plate to which the backlight module is disposed.

9. The touch display apparatus as recited in claim **6**, further comprising:

a light blocking element extending from the back plate to the edge of the touch substrate.

10. The touch display apparatus as recited in claim **8**, further comprising:

a light blocking element extending from the back plate to the edge of the touch substrate.

11. The touch display apparatus as recited in claim **6**, further comprising:

a front frame disposed at the edge of the touch substrate and including a blocking portion, which is disposed above the touch substrate and has a surface, wherein an angle is formed between an extension of the surface and an upper surface of the touch substrate, and the angle is between 5° and 30°.

12. The touch display apparatus as recited in claim **8**, further comprising:

a front frame disposed at the edge of the touch substrate and including a blocking portion, which is disposed above the touch substrate and has a surface, wherein an angle is formed between an extension of the surface and an upper surface of the touch substrate, and the angle is between 5° and 30°.

13. The touch display apparatus as recited in claim **1**, further comprising:

an appearance element disposed around the touch substrate and the display panel, wherein a top surface of the appearance element and a surface of the touch substrate have a height difference that is between 0 and 1 mm.

14. A touch display apparatus, comprising:

a display panel including a first substrate and a second substrate disposed oppositely, wherein the first substrate has a first side, the second substrate has a second side corresponding to the first side, and the first side is disposed beyond the second side;

a touch panel, including a touch substrate, wherein the second substrate is disposed between the touch substrate and the first substrate, and the area of the touch substrate is less than or equal to that of the second substrate;

a backlight module disposed on the side of the display panel away from the touch substrate;

a plastic frame adjacent to the backlight module, wherein the display panel is disposed to the plastic frame;

a back plate, wherein the plastic frame and the backlight module are disposed to the back plate; and

a light blocking element extending from the back plate to the edge of the touch substrate.

15. A touch display apparatus, comprising:

a display panel including a first substrate and a second substrate disposed oppositely, wherein the first substrate has a first side, the second substrate has a second side corresponding to the first side, and the first side is disposed beyond the second side;

a touch panel, including a touch substrate, wherein the second substrate is disposed between the touch substrate and the first substrate, and the area of the touch substrate is less than or equal to that of the second substrate;

a backlight module disposed on the side of the display panel away from the touch substrate;

an adhesive element by which the touch substrate and the display panel are connected to each other;

a back plate to which the backlight module is disposed; and

a light blocking element extending from the back plate to the edge of the touch substrate.

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